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June 27, 2001  
date

MISSILE LAUNCHER CELL WITH EXHAUST GAS UPTAKE DUCTS, AND ARRAY OF SUCH MISSILE LAUNCHER CELLS

Field of the Invention

- This invention relates to launchers
- 5 for canisterized missiles, and more particularly to such launchers which are intended for placement below a protective deck for generally vertical launch.

Background of the Invention

- 10 Modern warships rely principally on missiles, rather than cannon, for their offensive and defensive armament. Thus, a warship may include a single automatic cannon, together with one or more batteries of missile
- 15 launchers. A battery of missile launchers may include a single missile launcher array at the rear deck of the ship, and two similar arrays on the foredeck.

- A cluster of missile launchers for
- 20 use on a ship may be similar to that described in U.S. Patent 5,837,917, issued November 17, 1998 in the name of McNab et al. McNab et al. describe a structure providing five vertical bays or "sleeves" of five juxtaposed missile

launcher locations, held in a line array by muzzle-end, breech-end, and intermediate frames. Each sleeve of the missile launcher array of McNab et al. includes a support  
5 lattice dimensioned to accommodate a canisterized missile. Protection against blast and environment is provided by a hard hatch assembly which includes a plurality of individually controllable or openable hatches,  
10 each of which covers the end of one of the sleeves of the array. The breech ends of the sleeves open into a plenum, which is cooled by a water supply system. Cleats are provided for fastening the plenum to the underlying  
15 structure. The missile canisters with which the McNab launchers are used include a frangible protective seal at the muzzle and breech ends, and also include a missile ready for launch, presumably together with an  
20 electrical interface for providing information to the missile, if necessary, and for initiating the launch sequence as a result of external command. In order to use the McNab structure, one or more of the sleeve doors or  
25 hatches is opened, and a canisterized missile is lowered thereinto. While not expressly stated, an umbilical is presumably used to connect the missile canister to a portion of the launch control system near the sleeve, so  
30 that the missile may be remotely controlled. When that missile is to be launched, the door or hatch associated therewith is opened, and

the corresponding hatch of a further one of the sleeves, which does not contain a canisterized missile, is opened. Missile firing is then commanded, as a result of which the missile within its container fires, expelling exhaust gases into the plenum and emerging from the muzzle end of the canister, breaking both frangible seals as it does so. The exhaust gases entering the plenum from the missile are cooled by water injection, which lowers the temperature of the exhaust gases to thereby reduce the infrared (IR) signature, reduce erosion due to the gas temperature, and in so doing generate a large amount of steam. The mixed steam and exhaust gases are routed from the plenum to above-decks by way of the vacant sleeve with its open hatch, used as a chimney. If the support structure is a lattice, as McNab illustrates, a protective sleeve may run within that vacant one of the sleeves which is used as a chimney for exhaust gases/steam. The protective sleeve may include ablatable material for further protection.

Improved missile launchers are desired.

#### Summary of the Invention

A missile launcher cell according to an aspect of the invention is for accepting a canisterized missile which defines a missile launch end and a missile exhaust end, for, in use prior to missile launch, holding the missile canister in a generally vertical launch

position below a deck. The missile launcher cell comprises at least one elongated exhaust gas chimney. It also comprises a support structure defining a generally axial cavity, also defining a missile launch end and a missile exhaust end. The cavity of the support structure has length and cross-sectional dimensions sufficient to accommodate the missile canister. The one or more exhaust chimneys lie along the exterior of the support structure and extend, parallel with the axis of the cavity, from near the missile launch end to near the missile exhaust end of the support structure. The missile launcher cell also includes a missile exhaust plenum attached to the support structure near the missile exhaust end of the support structure. The missile exhaust plenum is coupled to the one or more exhaust chimneys near the missile exhaust end of the support structure. The missile exhaust plenum further includes an attachment arrangement for attachment to the missile exhaust end of the missile canister, for routing missile exhaust gas from the missile exhaust end of the support structure to the one or more exhaust chimneys, for causing missile exhaust gas to vent from the one or more chimneys near the missile launch end of the support structure of the missile launcher cell.

A door structure is attached to the missile launch end of the missile launch cell support structure, for, in the closed state, protecting

at least the support structure, the one or more chimneys, and any missile canister accommodated within the cavity.

In a particular embodiment of the invention, the cavity has a rectangular, or more particularly square, cross-section, and is dimensioned to accommodate a Mk 25 canisterized missile. The support structure may be a latticework. The number of chimneys in a particular embodiment is two, with the two chimneys running parallel with each other and with the cavity axis.

In a particularly advantageous embodiment of the invention, an array of missile launcher cells has each of the missile launcher cells of the array dimensioned for accepting a canisterized missile, where each missile canister defines a missile launch end and a missile exhaust end. In use prior to missile launch, the array of missile launcher cells holds the missile canisters in a generally vertical launch position below a deck. Each of the missile launcher cells includes at least one elongated exhaust gas chimney, and a support structure defining a generally axial cavity defining a missile launch end and a missile exhaust end. The cavity of the support structure of each cell has length and cross-sectional dimensions sufficient to accommodate a missile canister. The one or more exhaust chimneys are attached, or lie adjacent to, the exterior of the support

structure and extend, parallel with the axis of the cavity, from near the missile launch end to near the missile exhaust end of the structure.

- 5 A missile exhaust plenum is attached to the support structure near the missile exhaust end of the support structure of each cell. The missile exhaust plenum of each cell is coupled to the one or more exhaust chimneys near the missile exhaust end of the support structure, and also includes an attachment arrangement or means for attachment to the missile exhaust end of the missile canister, for thereby routing missile exhaust gas from the missile exhaust end of the support structure to the one or more chimneys, for causing missile exhaust gas to vent from the at least one chimney near the missile launch end of the support structure. A door structure is attached to the missile launch end of the missile launch structure, for, when closed, protecting at least the support structure and the one or more exhaust chimneys of the missile launcher cell, and any missile canister accommodated within the cavity of the cell, and for, when open, providing for egress of the missile from its canister and exhaust gas from the one or more chimneys. This arrangement allows the array of missile launchers to be maintained in a condition in which all of the launcher cells are fitted with canisterized missiles, without keeping at least one missile launch cell clear or unloaded so as to provide a chimney or path for the escape of
- 10
- 15
- 20
- 25
- 30

exhaust gas from a missile fired in a missile launch cell of the array. Thus, an aspect of the invention lies in an array of launchers in which a canisterized missile located within  
5 each of (all of) the cavities of the array.

Brief Description of the Drawing

FIGURE 1 is a simplified perspective or isometric view, partially cut away, of a representative array of four individual missile launcher cells according to an aspect of the  
10 invention;

FIGURE 2 is a simplified perspective or isometric view of a single missile launcher cell of FIGURE 1;

15 FIGURE 3a is a simplified perspective or isometric view illustrating details of the deck portion and hatch near the missile launch end of the missile launcher cell of FIGURE 2, and FIGURE 3b is a corresponding detail of the  
20 missile exhaust plenum near the missile exhaust end of the missile launcher cell of FIGURE 2;

FIGURES 4a, 4b, and 4c are simplified side elevation and plan views, respectively, looking in mutually orthogonal directions, of  
25 the missile launcher cell of FIGURE 2 with its hatch open, showing the individual exhaust gas management plenum, two exhaust gas chimneys or uptakes extending from the plenum to the muzzle or missile exit end of the launcher cell, and  
30 the door assemblage covering the missile launch exit and the chimneys;

FIGURE 5 is a simplified cross-

sectional elevation view of the single missile launcher of FIGURE 2, showing the location of the missile within the missile canister and a portion of the gas management system, including the plenum and one chimney, and the deck door or hatch.

Description of the Invention

FIGURE 1 is a simplified perspective or isometric view of an array 10 of individual missile launcher cells 10a, 10b, 10c, and 10d, with portions of the structure cut away to reveal interior details. In FIGURE 1, the individual cells 10a, 10b, 10c, and 10d are identical to each other. Each cell includes a lattice-type support structure designated 12, thus missile launcher 10a includes a lattice-type support structure designated 12a, missile launcher cell 10b includes a lattice-type support structure 12b, missile launcher cell 10c includes a lattice-type support structure 12c, and launcher cell 10d includes a lattice-type support structure 12d. Each support structure 12 includes four "leg" portions. Taking missile launcher cell 10d of FIGURE 1 as being representative, three such legs can be seen, namely legs 14d1, 14d2, and 14d3, and the fourth leg is not illustrated. The illustrated legs of support structure 12a of missile launcher 10a are 14a1 and 14a2, the illustrated legs of support structure 12b of missile launcher 10b are 14b1 and 14b2, and the illustrated legs of support structure 12c of



missile launcher 10c are 14c1 and 14c2. The legs of each support structure extend parallel with the missile launcher longitudinal axis; in particular, the various legs extend parallel to their corresponding launcher cell longitudinal axes 8a, 8b, 8c, and 8d.

A plurality of interconnecting support braces extend between the "legs" of the support structure of each missile launcher cell. As illustrated in FIGURE 1, representative support braces 20a1, 20a2, and 20a3 extend between leg elements 14a1 and 14a2.

The combination of these leg elements and support braces defines an elongated cavity (not clearly visible in FIGURE 1), having a rectangular or square cross-section, which extends vertically through each support structure 12a, 12b, 12c, and 12d. The cross-sectional dimensions of each such cavity are dimensioned to accommodate a canisterized missile, and to hold such canisterized missile in a vertical or about-vertical posture. In a particular embodiment in which the canisterized missile is a Mark 25 canisterized missile, the cross-section is ~~rectangular~~. SQUARE

A protective door or hatch assembly or structure is located at the upper or missile launch end of each missile launcher cell. More particularly, FIGURE 1 illustrates a hatch assembly 16a associated with missile launcher cell 10a, a hatch assembly 16b associated with missile launcher cell 10b, a hatch assembly 16c

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6/21/61

associated with missile launcher cell 10c, and  
a hatch assembly 16d associated with missile  
launcher cell 10d. Each hatch assembly  
includes a generally flat deck portion or deck  
extension, and a hatch covering one or more  
apertures by which one or more missiles may  
exit, and/or through which exhaust gases may  
vent. In FIGURE 1, hatch assembly 16a of  
missile launcher cell 10a has a deck portion of  
deck extension 16ad and a hinged hatch 16ah,  
hatch assembly 16d of missile launcher cell 10d  
has a deck 16dd and a hinged hatch 16dh, with  
the hatches illustrated as being in the closed  
position. Hatch assembly 16c of missile  
launcher 16c has a deck 16cd and an open hatch  
16ch. The hatch 16bh of hatch assembly 16b is  
illustrated in phantom to reveal a square  
missile-end "aperture" 18bm in which a  
canisterized missile (not illustrated in FIGURE  
1) may be accommodated, and additional chimney  
or exhaust uptake apertures 18bc1 and 18bc2.

Each missile launcher cell 10a, 10b,  
10c, and 10d of array 10 of FIGURE 1 also  
includes an a pair of missile exhaust gas  
uptake ducts or chimneys. In FIGURE 1,  
portions of the two chimneys associated with  
missile launcher cell 10a are designated 30a1  
and 30a2, and portions of the corresponding  
chimneys of missile launcher cell 10b are  
designated 30b1 and 30b2, respectively. The  
chimneys associated with missile launcher cell  
10c are designated 30c1 and 30d2, and those

associated with missile launcher cell 10d are designated 30d1 and 30d2 in FIGURE 1. The chimneys associated with each launcher cell extend from near the bottom, breech or missile exhaust end of each launcher cell to near the top, muzzle, or missile launch end of the launcher cell, and are generally parallel with the axis of the corresponding support structure. Thus, chimneys 30a1 and 30a2 extend parallel with the longitudinal axis 8a of missile launcher support structure 12a, chimneys 30b1 and 30b2 extend parallel with the longitudinal axis 8b of missile launcher support structure 12b, chimneys 30c1 and 30c2 extend parallel with the longitudinal axis 8c of missile launcher support structure 12c, chimneys 30d1 and 30d2 extend parallel with the longitudinal axis 8d of missile launcher support structure 12d. At their upper ends, the various chimneys or missile exhaust gas uptake ducts open into a region which lies under the doors or hatches of the corresponding missile launcher cell when that door or hatch is in its closed position. In FIGURE 1, the open ends of the two chimneys 30b1 and 30b2 are designated 18bc1 and 18bc2, respectively. The chimneys are preferably fastened to the corresponding deck plate, as by welding if the chimney is metallic, or by other suitable fastening method for other materials, as for example the chimneys 30b1 and 30b2 should be secured to deck plate 16bd. The corresponding

hatch 16bh, when in its closed state, covers both the two chimney openings 18bc1 and 18bc2 and also the upper end of the elongated, vertically oriented cavity associated with or  
5 defined by the support structure 12b.

In addition to the chimneys, each missile launcher cell 10a, 10b, 10c, and 10d of array 10 is associated with an exhaust gas plenum or manifold. Thus, a plenum 40a is  
10 associated with missile launcher cell 10a, a plenum 40b is associated with missile launcher cell 10b, a plenum 40c is associated with missile launcher cell 10c, and a plenum 40d is associated with missile launcher cell 10d.  
15 Each exhaust gas plenum includes an attachment arrangement for attaching the plenum to the support structure. In a particular embodiment of the invention, the attachment arrangement also supports a "dogdown" arrangement which  
20 provides secure attachment of the plenum to the lower end of the canister of the canisterized missile used therewith. In FIGURE 1, the attachment arrangement for the exhaust gas plenum of each missile launcher includes four  
25 bosses or structures of a set 42 of bosses. Thus, exhaust gas plenum 40a of FIGURE 1 includes on its upper surface four attachment bosses, each of which is designated 42a, spaced around a rectangular or square exhaust gas  
30 inlet port 44a. Similarly, exhaust gas plenum 40b includes on its upper surface four attachment bosses, each of which is designated

42b, spaced around a square exhaust gas inlet  
port 44b, exhaust gas plenum 40c includes on  
its upper surface four attachment bosses, each  
of which is designated 42c, spaced around a  
5 square exhaust gas inlet port 44c, and exhaust  
gas plenum 40d includes on its upper surface  
four attachment bosses, each of which is  
designated 42d, spaced around a square exhaust  
gas inlet port 44d. Each of the bosses of set  
10 42 is attached to the lower end of a leg of the  
associated support structure. As an example,  
the lower ends of the three vertically disposed  
legs 14d1, 14d2, and 14d3 of support structure  
12d of missile launcher 10d which are visible  
15 in FIGURE 1 are attached to those three bosses  
42d of plenum 40d which are nearest the viewer.

This effectively fastens the plenum 40d to its  
associated support structure 12d, with axis 8d  
of the elongated vertically-oriented cavity  
20 (not designated in FIGURE 1) associated with  
the support structure 12d overlying the missile  
exhaust gas entry port 44d of the plenum 40d.

The chimneys or missile exhaust gas  
uptake ducts of each missile launcher cell are  
25 connected at their lower, missile exhaust, or  
breech ends to corresponding apertures of the  
associated plenum, so that missile exhaust  
gases entering the plenum can be vented through  
the chimneys to a location near the upper,  
30 missile launch, or muzzle ends of the  
structure. More particularly, the lower ends  
of chimneys 30a1 and 30a2 of missile launcher

10a are connected to corresponding apertures 46a1 and 46a2 of plenum 40a, the lower ends of chimneys 30b1 and 30b2 of missile launcher 10b are connected to corresponding apertures 46b1 and 46b2 of plenum 40b, the lower ends of chimneys 30c1 and 30c2 of missile launcher 10c are connected to corresponding apertures 46c1 and 46c2 of plenum 40c, and the lower ends of chimneys 30d1 and 30d2 of missile launcher 10d are connected to corresponding apertures 46d1 and 46d2 of plenum 40d. The chimneys are thus supported at their lower ends by attachment to their respective plenums, and may be attached at their upper ends to their respective deck plates. In addition, further attachments may be made along their lengths to their respective support structures.

FIGURE 2 is a simplified perspective or isometric view of missile launcher cell 10d of FIGURE 1, standing alone. Elements of FIGURE 2 corresponding to those of FIGURE 1 are designated by the same reference numerals. In FIGURE 2, A portion of the drive mechanism which controls the operation of hatch 16dh is designated as 216. FIGURE 3a is a simplified perspective or isometric view of the upper, missile launch, or muzzle end 300 of the missile launcher cell 10d of FIGURE 2. In FIGURE 3a, elements corresponding to those of FIGURE 2 are designated by the same reference numerals. In FIGURE 3a, various sets of apertures or holes defined in the edge of the

deck portion 16dd are designated 316da1,  
316da2, 316da3, and 316da4. These sets of  
apertures are provided for allowing the use of  
bolts to fasten each deck portion to an  
5 adjacent deck portion of another missile  
launcher cell, in order to form an array such  
as that illustrated and described in  
conjunction with FIGURE 1, or to fasten the  
deck portion of the cell to an adjacent deck  
10 structure of the ship or other support  
structure on which it is mounted, a cut-away  
portion of which is illustrated in phantom as  
390 in FIGURE 3a.

FIGURE 3b is a simplified perspective  
15 or isometric view of a lower, missile exhaust  
end, or breech end 380 of the missile launcher  
structure of FIGURE 2, illustrating some  
details of the structure. Elements of FIGURE  
3b corresponding to those of FIGURE 2 are  
20 designated by like reference numerals. In  
FIGURE 3b, the structure of plenum 40d is seen  
to include legs or supports 339a, 339b, and  
339c, each of which defines a plurality of  
plenum-to-ship mounting or attachment holes or  
25 apertures 340d1, 340d2, and 340d3,  
respectively. In addition, details of the  
dogdown mechanism 360 include connecting drive  
bars 350a and 350b.

In FIGURES 4a, 4b, and 4c, elements  
30 corresponding to those of FIGURES 1, 2, 3a, and  
3b are designated by the same reference  
numerals. In FIGURE 4c, the aperture 418d

represents the end of the elongated cavity defined by the support structure 12d, and it is centered on axis 8d, which appears as a dot in the view of FIGURE 4c. FIGURE 4b illustrates axis 8d as centered in the view, while FIGURE 4a shows axis 8d as off-center relative to the entire structure. Axis 8d appears as off center in FIGURE 4a because it is centered on the support structure 12d, which is offset relative to the entire missile launcher cell 10d because of the presence of the chimneys 30d1 and 30d2.

FIGURE 5 represents a cross-sectional view of missile launcher cell 10d of FIGURE 1 shown alone, and partially cut away to show the missile 512 and a missile canister 510, defining a missile launch end 510ML and a missile exhaust end 510ME, with the missile 512 contained within the canister 510. In FIGURE 5, the hatch 16dh is open.

Other embodiments of the invention will be apparent to those skilled in the art. For example, while the support structure 12x of a cell 10x of the FIGURES are illustrated as being of a particular form of lattice, other types may be used, or solid (non-lattice) portions may be used. While the missile launcher array of FIGURE 1 shows a linear array of missile launcher cells, the array can be rectangular, so that it includes a plurality of rows and columns, and it may intermix rectangular or square with linear arrays of



missile launcher cells. While the plenum associated with each missile launch cell has been shown as being roughly cubical, it may be drum-shaped (that is, a portion of a right circular cylinder) or semispherical (some portion of a sphere, including a hemisphere). While the missile canister has been described as containing a single missile, the missile canister can be of the type containing a plurality of missiles.

Thus, a missile launcher cell (any one of 12a, 12b, 12c, or 12d of array 10, with 12d taken as typical) according to an aspect of the invention is for accepting a canisterized missile (510, 512) which defines a missile launch end (510ML) and a missile exhaust end (510ME), for, in use prior to missile launch, holding the missile canister (510, 512) in a generally vertical launch position below a deck (390). The missile launcher cell (16d) comprises at least one elongated exhaust gas chimney (30d1, 30d2). It also comprises a support structure (14d1, 14d2, 20d1, 20d2) defining a generally axial cavity (418d), also defining a missile launch end and a missile exhaust end. The cavity (418d) of the support structure (14d1, 14d2, 20d1, 20d2) has length and cross-sectional dimensions sufficient to accommodate the missile canister (510, 512). The one or more exhaust chimney (30d1, 30d2) lie along the exterior of the support structure (14d1, 14d2, 20d1, 20d2) and extend, parallel

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6/24/71

with the axis (8d) of the cavity (418d), from  
near the missile launch end (300) to near the  
missile exhaust end (380) of the support  
structure (14d1, 14d2, 20d1, 20d2). The  
5 missile launcher cell (16d) also includes a  
missile exhaust plenum (40d) attached to the  
support structure (14d1, 14d2, 20d1, 20d2) near  
the missile exhaust end (380) of the support  
structure (14d1, 14d2, 20d1, 20d2). The  
10 missile exhaust plenum (40d) is coupled to the  
one or more exhaust chimney (30d1, 30d2) near  
the missile exhaust end (380) of the support  
structure (14d1, 14d2, 20d1, 20d2). The  
missile exhaust plenum (40d) further includes  
15 an attachment arrangement (360) for attachment  
to the missile exhaust end (510ME) of the  
missile canister (510, 512), for routing  
missile exhaust gas from the missile exhaust  
end (380) of the support structure (14d1, 14d2,  
20 20d1, 20d2) to the one or more exhaust chimneys  
(30d1, 30d2), for causing missile exhaust gas  
to vent from the one or more chimneys (30d1,  
30d2) near the missile launch end (300) of the  
support structure (14d1, 14d2, 20d1, 20d2) of  
25 the missile launcher cell (16d). A door or  
hatch structure (16dh) is attached to the  
missile launch end (300) of the missile launch  
cell support structure (14d1, 14d2, 20d1,  
20d2), for, in the closed state, protecting at  
least the support structure (14d1, 14d2, 20d1,  
30 20d2), the one or more chimney (30d1, 30d2) and  
any missile canister (510, 512)

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accommodated within the cavity (418d).

In a particular embodiment of the invention, the cavity (418) has a rectangular, or more particularly square, cross-section, and is dimensioned to accommodate a Mk 25  
5 canisterized missile (510,512). The support structure (14d1, 14d2, 20d1, 20d2) may be a latticework. The number of chimneys (30d1, 30d2) in a particular embodiment is two, with  
10 the two chimneys (30d1, 30d2) running parallel with each other and with the cavity axis (8d).

In a particularly advantageous embodiment of the invention, an array (10) of missile launcher cells (16a, 16b, 16c, and 16d)  
15 has each of the missile launcher cells (16d) of the array dimensioned for accepting a canisterized missile (510, 512), where each missile canister (510, 512) defines a missile launch end (510ML) and a missile exhaust end (510ME). In use prior to missile launch, the  
20 array (10) of missile launcher cells (16d) holds the missile canisters (510, 512) in a generally vertical launch position below a deck. Each of the missile launcher cells (16d)  
25 includes at least one elongated exhaust gas chimney (30d1, 30d2), and a support structure (14d1, 14d2, 20d1, 20d2) defining a generally axial cavity (418d), and defining a missile launch end (300) and a missile exhaust end  
30 (380). The cavity (418d) of the support structure (14d1, 14d2, 20d1, 20d2) of each cell has length and cross-sectional dimensions

$$\frac{1}{2} \frac{G}{G+1}$$

structure (14d1, 14d2, 20d1, 20d2) and the one  
or more exhaust chimneys (30d1, 30d2) of the  
missile launcher cell (16d), and any missile  
canister (510, 512) accommodated within the  
5 cavity (418d) of the cell, and for, when open,  
providing for egress of the missile (512) from  
its canister (510) and exhaust gas from the one  
or more chimneys (30d1, 30d2). This  
arrangement allows the array of missile  
10 launchers to be maintained in a condition in  
which all of the launcher cells are fitted with  
canisterized missiles, without keeping at least  
one missile launch cell clear or unloaded so as  
to provide a chimney or path for the escape of  
15 exhaust gas from a missile fired in a missile  
launch cell of the array. Thus, an aspect of  
the invention lies in an array of launchers  
(10) in which a canisterized missile is located  
within each of (all of) the cavities of the  
20 array.